

# PATENT COOPERATION TREATY



# PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

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Applicant's or agent's file reference P200201667 WO		<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/DK 03/00909		International filing date (day/month/year) 19.12.2003	Priority date (day/month/year) 20.12.2002
International Patent Classification (IPC) or both national classification and IPC G01N23/222			
Applicant FORCE TECHNOLOGY et al.			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 4 sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li>I <input checked="" type="checkbox"/> Basis of the opinion</li> <li>II <input type="checkbox"/> Priority</li> <li>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li>IV <input type="checkbox"/> Lack of unity of invention</li> <li>V <input checked="" type="checkbox"/> Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li>VI <input type="checkbox"/> Certain documents cited</li> <li>VII <input type="checkbox"/> Certain defects in the international application</li> <li>VIII <input type="checkbox"/> Certain observations on the international application</li> </ul>			
Date of submission of the demand  07.06.2004		Date of completion of this report  25.02.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer  Rouault, P  Telephone No. +49 89 2399-2776 	

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. **PCT/DK 03/00909**

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, Pages**

1-16 as originally filed

**Claims, Numbers**

1-14 received on 07.10.2004 with letter of 05.10.2004

**Drawings, Sheets**

1/2-2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes: Claims	1-14
	No: Claims	
Inventive step (IS)	Yes: Claims	1-14
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-14
	No: Claims	

**2. Citations and explanations**

**see separate sheet**

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**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Reference is made to the following documents:

D1= GB-A-1180450

D2= GB-A-984566

D3= US-A-3707631

D4= PATENT ABSTRACTS OF JAPAN  
vol. 1999, no. 05  
31 May 1999  
& JP 11 051799 A (CHISAKA HARUO)

2. Closest prior art: document D1, which discloses an apparatus for detecting the hydrogen content of an object (see page 1, lines 10-12, of D1, and page 2, lines 14, 15 of the description of the application), which apparatus comprises (see the figure unique and page 1, lines 13-30, page 2, lines 10-35 of D1):
- a neutron source 3 that emits fast neutrons;
  - a detector device 2 for detecting thermal neutrons;
  - a moderator 5 that brakes and reflects neutrons upon collision.
3. The apparatus according to Claim 1 of the application differs then from the apparatus known from D1 in that:
- a) said detector device comprises:
    - a light-emitting unit that emits light in case of a nuclear event/reaction with a thermal neutron; and
    - a light-registering unit that emits an electric pulse/ an electric signal when a flash of light is detected;
  - b) said moderator is a light-conductive unit arranged between said light-emitting unit and said light-registering unit;
  - c) said neutron source is embedded in said moderator, i.e. in said light-emitting unit.

Since it is mentioned in D1 that the detector of thermal neutrons may be a

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scintillator (see page 2, lines 10-13), feature a) above is not considered to be inventive.

Furthermore, feature b) above is revealed in documents D2 (see page 2, lines 48-55, 66-74) and D3 (col. 4, lines 12-15, 22-26), and it would appear to be obvious to the skilled person knowing D1 and wishing to further improve the neutron moderating properties of the apparatus of D1 to use a scintillator, a light detector and a light-conductive unit between said scintillator and said light detector, which light-conductive unit also acts as a moderator.

Neither of the available documents, however, discloses or suggests feature c) above, which allows to obtain a more compact and more efficient detector. Especially, the apparatus of D2 does not require a neutron source and there is no hint in D3 to displace neutron source 22 to light-emitting unit 18. Document D4 reveals to arrange a neutron source in the effective center of a detector. Since the detector of the apparatus of D4 has a shape completely different from that of the detectors of D1-D3, a combination of one of these latter documents with D4 would not be contemplated by the skilled person.

In summary, for the reasons indicated above, the skilled person would need inventive skills in order to arrive at the invention defined in independent Claim 1.

Since independent Claim 8 is a method claim corresponding to independent apparatus Claim 1, its subject-matter, as well as that of the claims dependent on Claims 1 and 8, is also considered to be novel and inventive. The present application meets, therefore, the requirements of Articles 33 (2) and (3) PCT.

Amended set of claims:

### Claims

- 5           1. An apparatus for detecting the hydrogen content of an object (101),  
          wherein the apparatus (100) comprises
- a neutron source (103) that emits fast/energy-rich neutrons;
  - a detector device (102; 102a; 102b) for detecting thermal neutrons;
  - a moderator (104; 104'; 104'') that brakes and reflects neutrons upon
- 10           collision;
- characterised in that**
- said detector device comprises
    - a light-emitting unit (102b) that emits light in case of a nuclear
    - event/reaction with a thermal neutron; and
  - 15           ○ a light-registering unit (102a) that emits an electric pulse/an
  - electric signal (106) when a flash of light is detected;
  - said moderator (104'; 104'') is a light-conductive unit arranged
  - between said light-emitting unit (102) and said light-registering unit
  - (102a); and
  - 20           • said neutron source (103) is embedded in said moderator (104').
2. An apparatus according to claim 1, **characterised in that** said light-
- emitting unit (102b) is a scintillator and that said light-registering unit
- (102a) is a photo-multiplier (PM) or a photo-diode.
- 25           3. An apparatus according to claims 1-2, **characterised in that** said
- source (103) is arranged essentially in proximity of or about/in the
- centre of the face of said moderator (104', 104'') that adjoins the light-
- emitting unit (102b).
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4. An apparatus according to claims 1-3, **characterised in** that said light-conductive unit (104') is configured essentially with a face that adjoins said light-emitting unit (102b) and having a relatively smaller face adjoining a detection face (107) of said light-registering unit (102a).
- 5
5. An apparatus according to claims 1-4, **characterised in** that said light-conductive unit (104'') is configured for emitting light conducted from said light-emitting unit (102b) to the light-registering unit (102a) essentially perpendicular to a detection face (109) of the apparatus (100).
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6. An apparatus according to claims 1-4, **characterised in** that said light-conductive unit (104'') is configured for emitting light conducted from said light-emitting unit (102b) to the light-registering unit (102a) essentially in parallel with a detection face (109) of the apparatus (100).
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7. An apparatus according to claims 1-6, **characterised in** that the apparatus further comprises an electric circuit (105) connected to said detector device (102; 102a), wherein said circuit (105) is configured for generating a signal (108) that represents an estimated amount of hydrogen, water and/or humidity content on the basis of the electric signal (106) from said light-registering unit (102a).
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8. A method of detecting the hydrogen content (101) of an object comprising the steps of:
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- emitting fast/energy-rich neutrons from a neutron source (103);
  - detecting thermal neutrons by means of a detector device (102; 102a; 102b);
- 30

- braking and reflecting neutrons by collision of a moderator (104; 104'; 104''),

**characterised in that the method further comprises:**

- emitting light by a light-emitting unit (102b) in the event of a nuclear event/reaction with a thermal neutron;
- emitting an electric pulse/an electric signal (106) by a light-registering unit (102a) upon recording of a flash of light;
- conducting light from said light-emitting unit (102b) to said light-registering unit (102a) by a light-conductive unit arranged between said light-emitting unit (102b) and said light-registering unit (102a); of which said moderator (104'; 104'') is the light-conductive unit, where said neutron source (103) is embedded in said moderator (104').

9. A method according to claim 8, **characterised in that** said light-emitting unit (102b) is a scintillator and that said light-registering unit (102a) is a photo-multiplier (PM) or a photo-diode.

10. A method according to claims 8-9, **characterised in that** said source (103) is arranged essentially in proximity of or around/in the centre of the face of the moderator (104', 104'') that adjoins the light-emitting unit (102b).

11. A method according to claims 8-10, **characterised in that** said light-conductive unit (104') is configured essentially with a face that adjoins said light-emitting unit (102b) and having a relatively smaller face adjoining a detection face (107) of said light-registering unit (102a).



12. A method according to claims 8-11, characterised in that said light-conductive unit (104") is configured for emitting light conducted from said light-emitting unit (102b) to the light-registering unit (102a) essentially perpendicular to a detection face (109).

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13. A method according to claims 8-11, characterised in that said light-conductive unit (104") is configured for emitting light conducted from said light-emitting unit (102b) to the light-registering unit (102a) essentially in parallel with a detection face (109).

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14. A method according to claims 8-13, characterised in that the method further comprises generation, in an electric circuit (105) connected to said detector device (102; 102a), of a signal (108) representing an estimated amount of hydrogen, water and/or humidity content, wherein said generation is performed on the basis of the electric signal (106) from said light-registering unit (102a).

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